THE GLASS INDUSTRY

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GLASS TECHNOLOGISTS ASSEMBLE FROM TWENTY-THREE COUNTRIES

THE keynote of the Second International Congress on Glass, held in London and Sheffield, July 2-11, was international good-fellowship. Delegates numbering 283, from 23 countries, registered at London. Of these, 125 came from overseas. The German visitors numbered 29, French and Americans 17 each, and Czechs 12, with smaller delegations from countries as distant as South Africa, and Japan, with one delegate each. Unfortunately, delays in obtaining governmental permission kept the Russian delegates at home; and also Italy, where the first Congress of this kind was held in 1933, was not represented.

Each member wore a badge carrying name and nationality, printed on paper whose color indicated which of the three official languages he spoke—white for English, red for German, and blue for French. Many two-color badges, and not a few three-color ones, were worn by the Europeans. There was no language problem, because nearly everyone spoke at least a smattering of English, and the British and Americans made brave efforts at being polyglot.

The Congress was efficiently organized, under the leadership of President Dudding, and the staff work, directed by G. S. Duncan in the offices and Geoffrey Marchand at the head of House Committee and Stewards, was carried out with a skill and thoroughness that told of long and careful preparation. Mr. Cunningham, who handled registrations, and Mr. Moorshead, of the House Committee, should also be mentioned. Professor Turner, the dean of all glass technologists, modestly in the background, was responsible for planning the elaborate technical program, and deserves much of the credit for initiating and carrying out the whole affair.

Headquarters of the Congress in London were the Institution of Electrical Engineers, a fine, modern building at Savoy Place, off the Thames Embankment. Offices, lecture theatre, and excellent rooms for group meetings were provided in this building, and also a tearoom, where many informal conversations accompanied afternoon refreshment.

H.R.H. the Duke of Kent, third son of the late King, formally opened the Congress. After a brief introduction by President Dudding, the Duke spoke of the importance of the glass industry in modern civilization, and praised the co-operative spirit which brought together this earnest gathering of technologists from many nations. He welcomed the overseas delegates to Britain, and declared the Congress opened. One representative from each national delegation was received, in turn, before the Duke left the theatre. Francis C. Flint, President of the American Ceramic Society, went forward for the U. S. A.

Official photograph of the International Congress on Glass assembled before the Institution of Electrical Engineers in London. Photo courtesy of Rawood Ltd., London.

The delegates were then treated to a rare linguistic performance, to be repeated a number of times at non-technical sessions during the Congress. Miss Clara Baumann, official interpreter, read from her English shorthand notes clear, well-enunciated French and German versions of the addresses which had been made.

Dr. Thomas, of Berlin, presented the first paper at the general session which followed. He discussed the behavior of glasses upon lamp working, especially the bubble formation or actual foaming caused by volatilization of some constituents. Blackening by reduction and roughening by crystallization were shown in lantern-slide projection.

Professor Turner read the paper by himself and R. J. Holland on the breaking strength of glass. The work was done on strips or laths cut from flat glass. New diamonds or greater pressure in making the cut, resulting in more splintering of edges, was shown to weaken the specimen. Grinding and polishing the edges increased the strength, and when this was followed by fire-finishing, maximum values were obtained. As previous researches had shown, differences in strength values in freshly cut specimens were obtained, depending upon whether the cut surfaces were up (in compression) or down (in tension) during the test, the latter position giving the lower values. Greater values for modulus of rupture were obtained with smaller widths, just as in testing glass fibers.

H. Ota, of Japan, reported on glass compositions for drawn window glass, with particular attention to the ratio of CaO to MgO, as affecting devitrification and softening temperatures, viscosity, rate of melting, and durability. The last property is of great importance in Japan, because of the humid climate. The best all-round results were obtained where the CaO:MgO ratio was about 8:4 in one series, 9:4 in the higher lime series.

On the afternoon of July 2, the delegates, having previously chosen and been given cards for certain plant visits, were taken by bus to the United Glass Bottle Works at Charlton, to the James Powell & Sons (Whitefriars) Works at Wealdstone, or the G. E. Works and Laboratories at Wembley.

At the "Whitefriars" plant, one of the oldest in England, highly-skilled hand operations were in evidence. Direct coal-firing of closed-pot furnaces, as well as coke-firing of leers, were interesting features. Lovely colored pieces were shown, and cut and engraved ware. Panes for stained-glass windows were being made by blowing relatively small cylinders, opened out in a coke-fired oven. The glass mosaics on exhibition were also remarkable. As in all the other plant visitations, the officers of the Company took a direct personal interest in entertaining the party, and every hospitality and courtesy was shown the delegates. Mr. Orme, of the Board of Directors, made a jolly little speech at the tea concluding the visit, in which he welcomed the delegates to this plant, where craftsmanship in glassworking has been developing since 1680.

Needless to say, these bus trips presented excellent opportunities for seeing portions of London, and for getting glimpses of the beautiful English countryside, and of the small towns.

Other groups saw the very modern laboratories of the General Electric Co. as well as the Osram G. E. Co. factory, where bulbs and tubing are made by Westlake and Danner machines, respectively; and the United was a fine exhibition of modern bottle production by the Owens machine in the largest bottle works in Europe.

American participation in the programs began on Friday, July 3, with Dr. Hostetter in the chair for Technical Group I, while Maurach and Schulze of Germany and Preston and Duncan of Sheffield discussed Nomenclature and Bibliographies. A suitable definition for the term "glass," it was later laughingly admitted, could not be reached. Such a definition must include all truly ceramic glasses, and exclude organic products. We await the report of the International Commission.

Meanwhile, Group II, presided over by Dr. English of Sheffield, heard and discussed several papers on the determination of iron in glasses and raw materials. Miss Violet Dimbleby, whose analytical papers from the Sheffield Laboratory have brought her distinction as the only woman glass technologist of note, was secretary.

The colorimetric method, using thiocyanate, received most attention, with emphasis on standard preparation of samples and concentrations of reagents and standard iron solutions. This was the theme of Dr. Springer's (Ger.) paper, read by a colleague. Dr. Dietzel (Ger.) and Mr. Wood (Gt. Br.) proposed titration of ferric iron with titanous chloride, ferrous iron with cerium sulfate or potassium permanganate. Densem and Turner (Gt. Br.) reported a method for estimating ferrous and ferric iron, and discussed the difficulties involved. Spectrographic methods were handled by Cooper (Gt. Br.). Finn (U. S. A.) and Withey (Gt. Br.) added helpfully to the general debate.

Group III on the same morning gave its attention to the problem of testing tank blocks. Dr. Bartsch of Jena pointed out that testing by model tanks, by immersed rods, or by floating bodies, must show not only the durability of the block, but also its tendency to produce stones and cords, which may be greater for more durable blocks. Dr. Partridge (Gt. Br.) not only outlined a testing procedure, but proposed comparison of data from agreed tests by different workers, arriving at the establishment of approved methods. Mr. Hyslop (Gt. Br.) advocated petrographic and chemical studies of new and of heat-treated blocks, as giving useful predictions on behavior in use.

Group IV heard a paper on the historical development of cut glass, and visited the Victoria and Albert Museum to view illustrative material.

This forenoon has been described, since it was a typical half-day of the Congress. Departing from chronological sequence, we shall now cover some of the more interesting non-technical events of the Congress.

Dr. Hostetter gave a public lecture on Friday afternoon, on "The Casting of the 200-inch Telescope Disc." Sir William H. Bragg, famous English astronomer, presided. Dr. John C. Merriam, of the Carnegie Institution of Washington, was in the audience, and commented briefly at the close of the lecture. The slides and motion pictures, accompanied by Dr. Hostetter's lively flow of descriptive narration, made this event easily the most entertaining and enjoyable of all the formal sessions. It is evident that the interest abroad in this 200-inch disc is tremendous.

Members of the American delegation participated in several of the sessions. Flint presented a paper at the first Sheffield meeting, on decolorizing; Scholes was

chairman of the analytical group meeting, and his paper was read by Partridge in Group III; Sharp presided over Group II at the second Sheffield session, and read Dr. W. C. Taylor's paper on Glass Durability Methods; Navias reported on the American investigations of strength of glass, in London, July 9, and Finn gave tentative specifications for safety glass testing, at the same session. All of these men, as well as U. E. Bowes and N. W. Taylor, took active parts in the general discussions in the group meetings.

The delegates were entertained at two social functions that were truly magnificent affairs. First was the dinner and dance tendered by the Glass Manufacturers' Federation, at the Trocadero Restaurant in Piccadilly, July 3. The brief speeches, each made trilingual by Miss Baumann, indicated an enthusiastic friendliness and desire for international co-operation that reflected accurately the spirit of the Congress. After a couple of hours of dancing to an excellent orchestra playing mainly American fox-trots, delegates found themselves ushering in the Glorious Fourth by standing in a hollow square, hands linked with their British and Continental friends, singing "Auld Lang Syne" and "God Save the King!"

The second delightful affair, also carried out with a professional master of ceremonies, and with that perfection of food and service for which these famous London restaurants are noted, was the banquet given by the British Glass Technologists at Park Lane Hotel, on July 10. Lord Hirst of Witton, head of the British G. E. Co., proposed the toast to the Congress, to which President Dudding replied. Professor Turner gave "The Overseas Delegates," and responses were made by Francis C. Flint, President of the American Ceramic Society, and by Heinrich Maurach, Secretary of the German *Glastechnische Gesellschaft*. Mr. Flint stressed the great satisfaction that the American delegation had found in making personal friends with men who had hitherto been only names on the printed page. He also recalled that more than 130 Americans are members of

(1) Gutteridge of Great Britain and Ota of Japan; (2) Bon Voyage; (3) Marchand, executive secretary of the Glass Manufacturers Association; (4) Navias and Hostetter on the bounding main; (5) Dr. Gerhart Schott in the laboratory at Sheffield; (6) Nelson Taylor in a punt on the Isis; (7) Schultze of Germany; (8) Thomas of Germany with Hostetter behind; (9) Finn and Hostetter with Dufour of France; (10) Bartsch, Rohde, Hettinger, Hodkin and English; (11) Hettinger, photographer extraordinary; (12) A bus-load on a plant trip; (13) Geltsharp of the U. S. A; (14) Front: Hampton, Murgatroyd, Gooding, Moorshead: Middle row: Finn, Withey, Peddle, Goodlet, Berger; Rear row: Douglas, Holland, Dietzel. Photos by Hettinger and Scholes.

the Society of Glass Technology. Dr. Maurach spoke of his regret that the Congress was drawing to a close. He announced that Germany invited the presence of the third Congress in 1939, and aroused enthusiastic applause. Then, saying that tears were sometimes shed at parting, he presented to President Dudding a casket of "glassmaker's tears," the sign of the old guild. Dancing, with the introduction of an excellent cabaret performance at midnight, continued until 2:00 A. M.

Another brilliant function was the Government Reception at Lancaster House, July 9, when the Congress delegates were received by the Rt. Hon. Ramsay MacDonald and his daughter. Lancaster House, or London Museum, is the repository of some of the finest old glassware and china collections, and also of the coronation garments used since Geo. IV.

Rain fell about half the time, during the Congress, and it marred somewhat the Derbyshire excursion, a bus ride over the moors to the south of Sheffield. The spirits of the party were not dampened, however, and when, after our dinner of ham and eggs in a country tavern, Louis Navias got at the piano and a few songs went around, the Czechs responded with two lively ditties, and the Yorkshire contingent sang one with as many verses as there are names for the same London street.

The visit to Oxford on Sunday was made under blue skies, and presented a fine opportunity to view the halls and towers of that ancient University. Space does not permit mention of the interesting places shown by the guides. The Lady Mayor of Oxford addressed the party of 125 at lunch, and pointed out that Oxford, with its new motor-car factory, is now also an industrial city.

At Sheffield, too, next day, the delegates were received by the Mayor, at an official luncheon where 162 were present. These occasions indicate the important place accorded to the Congress by public officials.

Meanwhile, each morning except Saturday and Sunday was taken up by technical sessions or group meetings. At the second general session, Dr. B. Long (Paris) reported upon the interesting novelty, "Multicellular

(1) An exhibit at Whitefriars; (2) Navias, the Hostetters, Finn and Hettinger; (3) Berger of Germany, Dudding of England and Bowes of U. S. A; (4) Miss Violet Dimbleby in her laboratory; (5) Looking for land; (6) Dudding, the Duke of Kent, Lord Hirst, Turner; second row: Meigh, Maurach, Kennedy, Hostetter; rear: Marchand and secretary of H. R. H; (7) A group with the Finn nieces on either side of Senora de Artigas; (8) Dr. E. Berger; (9) First row: Long, Mrs. Turner, Turner, Polivka; second row: Dufour, De Artigas and Muehlig; (10) Long, Maurach and Dufour; (11) Polivka of Czecho-Slovakia with Rhode, Berger and Bartsch of Germany; (12) Versen and Ctyroky of Czecho-Slovakia, Turner, Flint and Polivka. Photos by Hettinger and Scholes.

Glass," which consists of small cells or bubbles surrounded by glass walls. The Germans call it "Foam Glass," which is very descriptive. In its lightness, and low conductivity of sound and heat, it offers possibilities in building construction.

At the third general session, July 6, the delegates were welcomed by Dr. Pickard-Cambridge, Vice-Chancellor of Sheffield University. A brief reply was made by F. C. Flint, who presided. Dr. E. Berger, Jena, presented one of the outstanding papers of the Congress, on "Fundamental Principles Underlying the Chemical Corrosion of Glass." He disclosed an optical method for measuring, by the interferometer principle, the thickness of the layer of glass dissolved from a flat surface. Because the laws that have been deduced for relation between corrosion and time are parabolic and logarithmic in character, two points on the time curve are necessary to establish the corrosion rate for a given glass. Moreover, the glass must be previously untreated, and the surface area must be known. This paper was received with enthusiasm, as a scientific approach.

The succeeding paper, by Drahonovsky, was a general and historical account of Bohemian methods of decorating glass. Engraving was dwelt upon as the most highly developed and as yielding the most beautiful objects of art.

Partridge and Lait (Gt. Br.) exhibited fine specimens of small refractory articles formed from pure oxides, with a minimum of bonding agent, by high pressure in steel molds. Slip casting was also employed. Alumina, magnesia, and zirconia were the principal oxides used. Clean-cut, mold-size articles resulted.

On the afternoon of July 6, a visit was made to the Department of Glass Technology, Darnall Road, a well-known address. Here the laboratories, lecture room, and furnaces are housed in the buildings formerly occupied by a small glass works. From here the motor coaches took the party to "Elmfield," a large residence in the suburbs of Sheffield, which will soon be made over into a home for the Department. Since so much has been accomplished in the cramped quarters at Darnall Road, it is interesting to speculate what strides will be made, when the fine new laboratories, whose plans were shown, are ready for Professor Turner.

The secretary for the analytical group on July 7 was Dr. Deschamps, (Belg.), a graduate of the Massachusetts Institute of Technology. Miss Dimbleby reported on the rapid method of glass analysis, based on decomposition by H_2F_2-$H\,SO_4$. The conclusion was reached that results are equally as good, for control purposes, as those obtained by the slower method by soda fusion. Emphasis was laid on the necessity for complete removal of fluorine, accomplished by heating the acid-sulfate residue to low redness.

A. R. Wood (Gt. Br.) showed an amazing method of alkali determination, using 0.080 g. samples formed by blowing the glass into irridescent bubbles, then treating in an autoclave at 200 lb. in water for one hour, in a nickel cup, and titrating the dissolved alkali by N/50 acid.

R. F. R. Sykes (Gt. Br.) found that 8-hydroxyquinoline could be depended upon to remove Al and Mg in the Berzelius method for alkali.

B. S. Cooper (Gt. Br.) made a conservative report on the application of spectrographic methods. He showed that as a qualitative indication, the spectrograph is both rapid and reliable for most elements, giving by the relative intensity of lines a roughly quantitative estimation.

Some analytical problems in need of solution were suggested to the International Committee, including boron and fluorine, especially in the presence of phosphates and antimony.

Sub-group 2, meanwhile, was similarly going over the problem of decolorizing. E. J. Gooding (Gt. Br.) dealt with the influence of such reagents as arsenic, niter, and sulfates on selenium decolorizing, and with the effect of heat treatment and sunlight. Densem and Turner (Gt. Br.) dwelt on the necessity of knowing the amount of iron present, and the ferro-ferric equilibrium, as affected by concentration, time, temperature, viscosity, and chemical influences. A. Dietzel and L. Springer (Ger.) contributed to the discussion, and F. C. Flint reviewed modern progress in decolorizing, showing that the industry is profiting by a rather well-organized and effective knowledge of the subject.

The papers of Group III on Regenerator Packings (Checkers) were not available. Two of these dealt with the properties of the brick used, emphasizing the matter of corrosion by flue dust, and one with the superiority of brick from artificial mullite. The papers in Group IV were likewise not available.

Group II on July 8 treated the subject of chemical corrosion, lately handled by the Glass Division of the American Ceramic Society. Dr. Berger (Ger.) reported on statistical analysis of grain size and form factors, as affecting surface exposed to attack. These depend, in turn, on methods of crushing and sieving, which must be specified. It was pointed out that repeated grinding tends to produce rounded rather than flat grains. Average grain volume is independent of composition or thermal history.

D. E. Sharp read Dr. W. C. Taylor's paper, reporting on A.C.S. No. 1 method, already familiar to our readers. The results on glass of widely different types, in different reagents, show such variations that reagents must be specified to get comparable results. Prof. Turner (Gt. Br.) commented on various applications of the powder method, and hoped that these could be reconciled. A. R. Wood (Gt. Br.) reported a rapid method consisting in placing prepared grains, washed in $C\,Cl_4$, in three standard indicator solutions, and observing pH by the

Americans attending the Congress:

F. C. Flint and Mrs. Flint
F. Gelstharp
U. E. Bowes and Mrs. Bowes
D. E. Sharp and Mrs. Sharp
J. C. Hostetter and Mrs. Hostetter
J. Earl Frazier and Mrs. Frazier
James Slayter and Mrs. Slayter
A. N. Finn and two nieces
N. W. Taylor
Louis Navias
C. M. Franzheim
E. L. Hettinger
S. R. Scholes

The Congress on the steps of Wapping Hall, University of Sheffield. Photo by courtesy Newsphotos Press Agency, Sheffield.

colors produced. Dr. A. Cousen (Gt. Br.) proposed a test for bottles, by the extraction from the inner surfaces when placed in boiling water for five hours. This is definitely a product test, depending upon other factors than the composition. M. Herbert (Fr.) described the classification of laboratory glassware by testing with reagents related to the intended use—water, HCl, Na_2CO_3, NaOH solutions.

The group agreed to report to the International Committee that some form of the powder method should be adopted, and that an effort should be made to adopt suitable sieve specifications.

As a plant visit, many of the delegates chose the British Thomson-Houston Co., at Chesterfield, and others visited Hadfields, Ltd., at Sheffield. The B. T. H. plant is thoroughly modern, and equipped to produce ordinary bulbs by Westlake and Ohio machines, tubing by Danner machines, bulbs as small as 8 mm. by machine from tubing, and X-ray bulbs up to 300 mm. by mouth.

The railway journeys, to Oxford, to Sheffield, and back to London, were enjoyable features. Special cars were reserved for the Congress, permitting visiting back and forth between various groups of delegates. The return to London was in restaurant cars, in which the service of an excellent dinner added to the enjoyment of the scenery of the Midlands.

Technical Group II, July 9 and 10, brought out a very lively discussion of mechanical strength and its measurement, as well as thermal endurance. Dr. Long presided, and Dr. Gooding, as Secretary, interpreted. Dr. E. Albrecht (Ger.) gave a general discussion of the problem, pointing out that composition had less influence than experimental conditions. The study must be developed, because of the increasing use of glass as a structural material. Holland and Turner (Gt. Br.) reported studies on breaking specimens of flat glass, already described. Dr. W. M. Hampton (Gt. Br.), in studying the breakage of beakers by thermal shock, has discovered the empirical relationship that the temperature difference that can be sustained by a specimen of given shape—beaker or rod—is inversely proportional to the square root of the thickness. This proposal was accepted as a tentative correction to be applied in correlating results and so reported to the Committee.

Dr. Navias reported on the work of the A.S.T.M. subcommittee, showing the great variations obtained in testing rods, depending upon surface conditions, when cross-breaking tests are applied.

A. N. Finn pointed out the necessity for specifying exactly what is meant by annealing or heat treatment, in its influence on strength; and he also described the tentative specifications laid down for testing safety glass by the American Standards Association. These include such matters as discoloration by ultra-violet light, response to humidity and boiling-water tests, fracture under falling-ball tests, and distortion when viewed by projected light.

Dr. Berger was in the chair July 10, ably assisted by Mr. Douglas (Gt. Br.)

The plant visits of July 9 included one to the Rockware Glass Syndicate at Greenford. This plant was a fine example of straight-line production of bottles on Lynch machines, with Hartford-Empire leers and stackers, modern conveying machinery, and thorough testing methods. Since Britain is not as well endowed with pure silica deposits as some of our States, this Company finds it advisable to treat an impure sand by a process devised by their chemist, Dr. Adams.

In striking contrast was the plant of Messrs. Hailwood and Ackroyd, near Leeds, visited on July 7, where the delegates saw some fairly antique methods of producing glass for miners' lamps, advertising globes, and other illuminating purposes. Here the annealing was done by stacking the ware in kilns, heated by open coke fires.

The final plenary session of the Congress, on the afternoon of July 10, was devoted to reports by the officers on the statistics of the meeting, and to general expressions of satisfaction as to its success and its effect on international co-operation in our common task.

THE INDENTIFICATION OF STONES IN GLASS

By C. L. THOMPSON*

A GLASS stone is a segregation of crystalline, or non-glassy, material in the glass. They may be classified, according to their source, as batch stones, devitrification stones, and refractory stones. Some stones can be identified by visual inspection but for many of them, identification requires the use of the polarizing microscope.

Glass stones are most easily examined by making a thin section of the stone. Many stones may be identified from the examination of such a thin section, but for others, particularly products of devitrification, the measurement of the optical properties of the crystalline material present, using a powdered sample in immersion oils, is necessary. The satisfactory separation of a small stone from the glass is sometimes a difficult matter, but may usually be accomplished by crushing the stone and selecting the crystalline material under a low-power magnifying glass. The desired particles may be picked out with a pair of forceps and ground to powder in a small agate mortar with a few drops of benzene or alcohol to prevent loss of material. The benzene or alcohol may then be allowed to evaporate and does not interfere with the use of standardized immersion oils.

Types of Stones

In this paper, the stones most frequently encountered are described, and micrographs made from thin sections of typical stones are shown. The optical properties of the minerals mentioned may be found in standard texts on optical mineralogy.

Batch Stones—Batch stones are usually undissolved sand grains, but lumps of lime or segregations of color oxides may be encountered.

The sand grains are usually easily distinguished by their characteristic shape and their crystalline nature. There may be a center of residual quartz, usually with cracks showing inversion to cristobalite and this center surrounded by a fringe of tridymite or cristobalite that has crystallized from the highly siliceous glass, as shown in Fig. 1. A sand grain showing a greater degree of reaction with the glass is illustrated in Fig. 2. This consists of a center made up of wedge-shaped twins of tridymite, surrounded by single needles of tridymite and dendritic growths of cristobalite that have formed by recrystallization.

Devitrification—Devitrification results if a glass is held at a suitable temperature below the liquidus for the composition for a sufficient length of time. The occurrence of devitrification does not necessarily mean that these conditions have been fulfilled for the average composition of the glass, for non-homogeneity may exist due to any of the various causes.

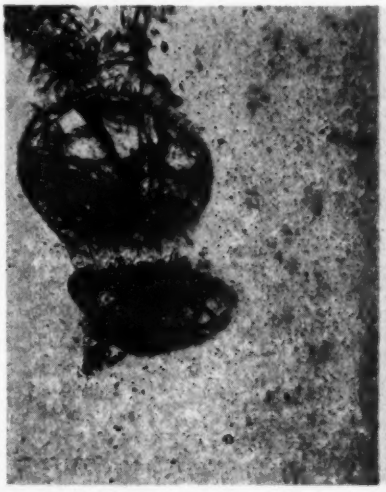
The common products of devitrification of soda-lime-silica glasses are tridymite or cristobalite (SiO_2), devitrite ($Na_2O \cdot 3\ CaO \cdot 6\ SiO_2$) and wollastonite ($CaO : SiO_2$). Occasionally, the high temperature form of calcium metasilicate, pseudo-wollastonite, is encountered, but this is rare since it forms only above 1200°C. If a dolomitic limestone is used, then diopside ($CaO \cdot MgO \cdot 2\ SiO_2$) occurs instead of wollastonite.

Fig. 3 shows tridymite needles that have crystallized from a bottle glass. Tridymite formed by devitrification is usually as single crystals rather than the wedge-shaped twins found in the centers of batch stones. Fig. 4 is a photograph made from the thin section of devitrified glass found in a dead corner of the same tank as Fig. 3. It shows several large lath-shaped crystals of tridymite and growths of cristobalite in typical "fern-leaf" pattern.

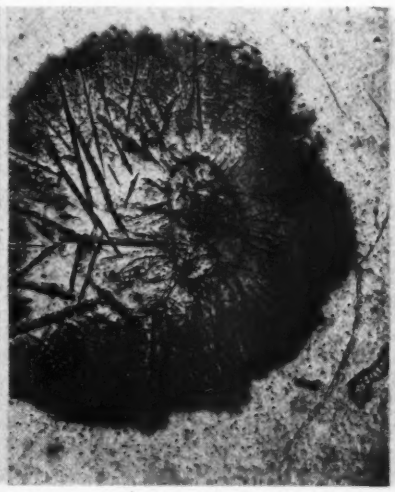
Fig. 5 is a photograph of a spherulite of devitrite that occurred along cords in a rolled sheet glass. Devitrite is the primary phase of many commercial glass compositions.

Fig. 6 is a photograph of a spherulite of wollastonite; and pseudowollastonite is shown in Fig. 7.

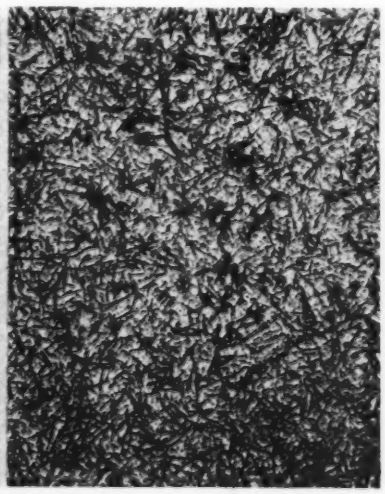
* Department of Ceramic Engineering, University of Illinois, from a paper read at the Fourth Conference on Glass Problems at Urbana, Ill.



1. Sand grains showing slight reaction with glass (x80).



2. Sand grain showing greater reaction with glass (x80).



3. Devitrified bottle glass (x360).

4. Devitrified glass from dead corner of bottle glass tank. Tridymite and Cristobalite (x380).

5. Spherulite of Devitrite that occurred along cord in sheet glass (x32).

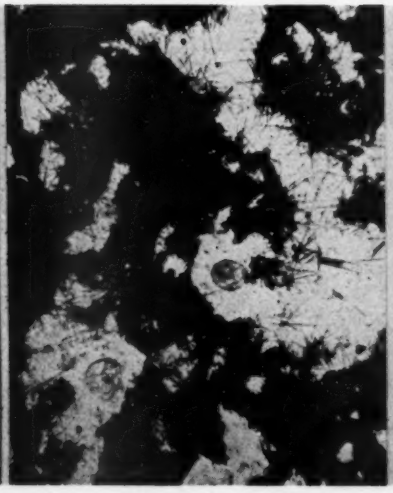
6. Wollastonite (x80)

7. Psuedowollastonite (x160).

8. Large corundum crystals from above metal line (x80).

9. Portion of fragment from silica superstructure that has fallen into the glass (x80).

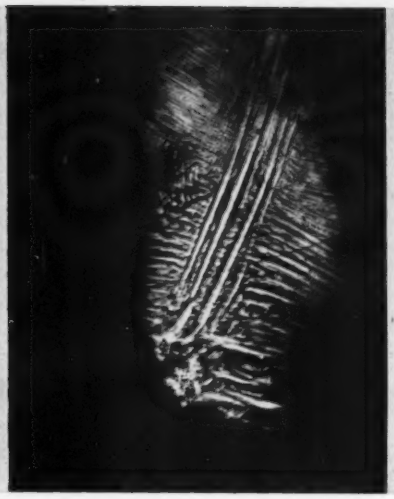
10. Fragment of siliceous clay refractory that has reacted little with the glass (x160).



11. Refractory similar to Fig. 10 that has reacted to a greater extent (x160).

12. Portion of flint fireclay grog that has floated out into the glass (x80 ordinary light).

13. Same as Fig. 12 taken with crossed Nicols, showing the nephelite surrounding the grog grain.



14. Flint fireclay grog grain completely altered to carnegieite. Crossed Nichols (x160).

15. Large mullite crystal altered to corundum and nephelite by the glass (x80).

Refractory Stones—In general, two types of refractory stones can be distinguished—those from above the glass line and those from below the glass line.

As is known from the equilibrium diagram of the silica-alumina system, in compositions containing only alumina and silica, mullite ($3\ Al_2O_3 \cdot 2\ SiO_2$) decomposes at 1810°C into corundum (Al_2O_3) and liquid if the alumina content is above 55 per cent. As was pointed out by Insley, the effect of the soda of commercial glasses is to reduce the temperature at which the decomposition of mullite occurs and to cause it to take place in compositions containing much less than 55 per cent alumina.

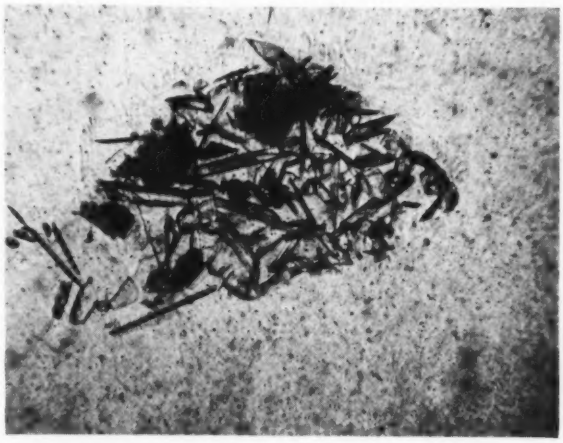
Therefore, the result of glass batch dust or vapor on clay refractories above the metal line is the formation of a layer of large corundum plates on the surface of the refractory. If the amount of liquid and its viscosity become suitable, these may flow down into the glass and, as corundum is difficultly soluble, usually persist as a stone of large, hexagonal corundum plates, the individuals of which are sometimes ¼ inch or more in diameter. Such a stone is shown in Fig. 8.

Stones from the silica super-structure are usually made up of tridymite or cristobalite, or both. Fig. 9 shows a fragment of silica brick that has dropped into the glass that still exhibits the original structure of the brick. Stones from silica brick that have reacted to a greater degree with the glass or ones derived from drippings from the crown may be difficult to distinguish from stones containing cristobalite or tridymite derived from scum or from devitrification.

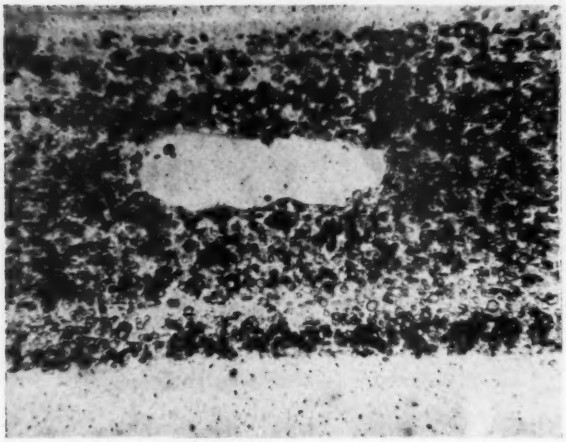
In stones derived from the refractory below the metal line, one may frequently get an idea of the portion of the tank or type of refractory from which the stone was derived.

Fig. 10 shows a piece of siliceous clay refractory that has reacted but little with the glass and was undoubtedly derived from the working end of the tank. The quartz is undissolved and the mullite crystals of the clay portion are very small. A portion of a stone derived from the same type of refractory, but that has reacted with the glass to a greater extent, is shown in Fig. 11. The quartz grains are largely dissolved—two inverted remanents may be seen in the lower middle portion of the picture—and the mullite needles have grown so the individuals are readily recognized.

A section of a portion of a stone derived from a flint fire clay grog particle of the refractory is shown in Figs. 12 and 13. The latter was taken with crossed nicols. The center, opaque portion is the unaltered flint clay which is surrounded by a fringe of small mullite needles and hexagonal corundum plates. Around this is a portion made up chiefly of nephelite ($Na_2O \cdot Al_2O_3 \cdot 2\ SiO_2$)—the white portion in Fig. 13—that has apparently crystallized during cooling from the highly aluminous glass resulting from the solution of the flint clay. The final stage of the solution of a flint fire clay particle by the glass is shown in Fig. 14. This is made up almost entirely of carnegieite—the high temperature equivalent of nephelite—with only a few minute corundum crystals in the lower portion. Such stones usually appear completely glassy except between crossed nicols because the refractive indices of carnegieite are near that of soda-lime glasses and those



16. Similar to Fig. 15, but more highly altered by the glass (x80).



17. Refractory stone from below glass line composed of corundum and carnegieite (x160).

of nephelite, which may occur, are not very different from the index of refraction of the glass. In fact, lumps of completely glassy material are sometimes encountered as a result of the complete conversion of the refractory to glass, but which persist as a lump because of the higher viscosity of the aluminous glass.

Stones derived from refractories that are higher in alumina than flint fire clay usually consist entirely of corundum and nephelite or carnegieite. Fig. 15 shows what was formerly a large mullite crystal that has been altered by the glass to minute corundum crystals and nephelite. A similar crystal that has reacted with the glass to a greater degree is shown in Fig. 16. Larger corundum plates surrounded by carnegieite are shown in Fig. 17. Stones of this latter type are sometimes difficult to distinguish from those from above the metal line, but the corundum crystals are usually not as large, and an examination of several stones will make positive identification possible.

REFERENCES

Bowen, "Identification of Stones in Glass", Jour. Am. Cer. Soc., 1, 595 (1918).

Insley, "A Study of the Origin and Cause of Stones in Glass", Jour. Am. Cer. Soc., 6, 706 (1923).

Peck, "A New Glass Stone", Jour. Am. Cer. Soc., 9, 351 (1926).

Insley, "Determination of the Source and Means of Prevention of Stones in Glass", Jour. Am. Cer. Soc., 11, 812 (1928).

PUBLICATIONS RECEIVED

Developments Affecting the American Potash Industry. By Howard I. Smith. Technical Publication No. 722. American Institute of Mining and Metallurgical Engineers.

The Chief of the Mining Division of the U. S. Geologic Survey has prepared this publication to continue through the year 1935 the story of the development of an independent domestic potash industry. From a production of some 1,090 tons of pure potash in 1910, the industry has grown until in 1935 it produced about 600,000 tons of potash salts and exports to no less than 22 foreign countries. This production, with an estimated 200,000 tons of pure potash is a gain over 1934 with a production of 144,342 tons of pure potash.

Applications of Potash in the Ceramic Industry. By Nelson W. Taylor. Contribution No. 101. American Institute of Mining and Metallurgical Engineers.

The basis of this paper is the availability of potash which makes it desirable for the potash producer to develop new applications and markets for his product. It is suggested that glasses, enamels and glazes "furnish the most likely market for potassium compounds, since a certain amount of alkali flux is needed in their composition."

Lime. By Oliver Bowles and D. M. Banks. I. C. 6884. Department of the Interior, Bureau of Mines.

The purpose of this paper is to present a general picture of the lime industry as a whole. The abundant literature on the subject has been abstracted and quoted freely and those interested in finding more detailed information on specific branches of the industry will find frequent references in the footnotes and bibliography. Sections are devoted to refractory bricks and to the problems of producing glass. Also included is an interesting table showing the major industries to which lime has contributed during the years from 1912 to 1934.

SAFETY GLASS FOR GLAZING AUTOS

The motor-vehicle laws of several States require the use of safety glass conforming to the safety code recently adopted by the American Standards Association as American Tentative Standard Z26.1-1935.

The preparation of this safety code National Bureau of Casualty and Surety Underwriters, and the tests include for resistance to impact as determined by dropping: (1) a half-pound steel ball (2) a 7-ounce steel dart, (3) an 11-pound shot bag onto the glass from appropriate heights. In some cases the glass does not break and in other cases the type of fracture is the deciding factor. The glass was also tested for discoloration by exposing it to radiations from a quartz-mercury lamp and to the effect of moisture at 125° F. and 70-per cent relative humidity. Glass for use as windshields was also tested for distortion by projecting the image of a straight line through the glass.

Several of the States asked the Bureau to make the tests for them. Nine domestic manufacturers of safety glass furnished 768 samples representing 32 types of glass which were then tested. There are three kinds of safety glass covered by the code, namely, laminated glass, wire glass (meshed wire), and the so-called heat-treated or case-hardened glass.

Reports of the tests were sent to motor-vehicle regulatory officials of 22 States who requested them and will be used (when applicable) by those officials for establishing lists of safety glass acceptable in those States. Reports may also be obtained by any other State official desiring them.—*Technical Bulletin of the National Bureau of Standards, July*, 1936.

REVISION OF MIRROR STANDARDS

National Bureau of Standards of the Department of Commerce report that the Standing Committee has approved certain changes in the Commercial Standards on Mirrors, CS27-30, as submitted by the Mirror Manufacturers Association on May 22, 1936. The revision contemplates a change in title, eliminates Grade AA plate glass mirrors, and incorporates the so-called shock or window glass mirrors. These Recommended Revisions have been submitted to producers, distributors and users of mirrors for written acceptance, prior to publication by the National Bureau of Standards.

GLASS BATCH PREPARATION

LACK of suitable attention to the mixing and handling of the glass batch invariably will lead to numerous manufacturing difficulties. The correct sequence of the reactions that take place in the furnace, the physical and chemical homogeneity of the glass and the working properties of the glass depends upon the uniformity of the mixture being fed into the doghouse of the furnace. Improperly mixed or demixed batch will result in a glass that will cause forming and fabrication difficulties, excessive breakage in the leers, storage or in use, in addition to other difficulties. This is true regardless of the type of ware being produced.

Any discussion of batch mixing and handling naturally starts with the batch mixing plant. The type of batch mixing plant found in most factories is one in which the raw materials are stored in overhead bins and the materials collected in a power driven car running under or alongside of the bins. This collecting car also serves as the mixer. In some cases the material is weighed directly into the car while, in others, the material is first weighed into a hopper attached to the storage bins and then fed into the car. This latter method employs a stationary weighing unit and requires less care to insure the desired accuracy than the former in which the weighing equipment is portable and therefore needs more maintenance. Regardless of the weighing system used a good first step towards insuring the accuracy of the raw material scales is the adoption of a routine scale testing procedure. With the portable scale equipment it is necessary to check the scale at each delivery point rather than at a single point as a slight inequality in the track at a delivery point may be sufficient to throw the scale off of balance at this point while reading correctly at other points.

When considering the type of mixer that should be used it must be remembered that the chief requisite of a good mixer is to produce a homogeneous mixture in the shortest time. While this requisite is easy to define it is difficult to say offhand that Mixer A is better than Mixer B or vice versa unless actual working tests of the mixers are made. The time required for a mixer, regardless of type, to produce a homogeneous mixture depends upon the following factors: the kinds of material being mixed together, the grain sizes of these different materials, the proportions of the various materials, and the total weight of the mixture.

In the actual mixing of the batch it is good practice to always introduce the various materials into the mixer in some regular order such as, in the case of a sand-soda-lime batch: 1.—Sand; 2.—Decolorizer, colors, and/or other small weight materials: 3.—Soda ash; 4.—Feldspar; 5.—Lime; 6.—Cullet. The time required to complete the thorough mixing of the materials after their introduction into the mixer varies between three to six minutes depending upon the type of mixer. The exact time must be determined by tests conducted under the conditions actually in the individual batch plant.

A good method of conducting such a test is to mix batches for different time intervals, taking several samples from each mix as it is discharged from the mixer. The analysis (both chemical and mechanical) of these samples when compared with the theoretical analysis of the batch will enable a mixing time to be set which will produce a mix showing the minimum divergence from the theoretical figures.

After the batch is mixed the method of conveying it to the doghouse of the furnace without demixing the batch becomes the chief problem. Again it becomes difficult to outline a single conveying system that will work in every plant as the arrangement and type of equipment used is often determined by the physical layout of the factory. Each installation must be considered separately remembering that the less distance a mixed batch has to be transported by mechanical means, such as conveyors, the less chance is there for the batch to become demixed.

The ideal arrangement is to convey each batch, as it comes from the mixer, in a single unit. This is successfully being done in several small plants of one to two tank capacity. Each mixed batch as it comes from the mixer is transferred to an individual hopper bucket and then conveyed to the doghouse by means of a monorail system and then discharged directly into a small storage tank above the doghouse. This method is not practical in large plants and the mixed batch must be conveyed in the best possible manner to the batch storage tank at each furnace.

The batch storage tank is probably the worst offender in causing demixed batch. If suitable baffles are not installed in the storage tank the flow of the mixed batch both into and out of the tank will be such that materials of different density will tend to separate and the batch when fed into the doghouse will show various degrees of demixing. Even with suitable baffles in the tank a certain amount of demixing is bound to take place and if the storage tank is not cleared free of batch at regular intervals segregation of the various grain size materials will occur and in time break loose from their pockets and cause extremely cordy or patchy glass.

As a check on whether demixing of the batch occurs in the installation and as a means of determining the exact location or the operation causing the demixing, it is recommended that samples of batch be taken all along the line from the mixer to the doghouse and the composition of the samples determined and compared with the composition of the batch as it leaves the mixer. Such checks should be part of the regular routine control because the locating and correcting of demixing troubles as they occur will soon pay for itself in terms of better production and less bad glass.

MOVIES OF SUPER-REFRACTORIES

The research laboratories of the Carborundum Co. have created a very unusual motion picture film entitled "Super-Refractories Through the Microscope," which is available for showing before interested technical societies. The first part of the film shows the structure of various refractories materials as they appear on the stage of the polarizing microscope, while the second part graphically shows the actual behavior of various types of refractories under severe operating conditions.

The New York City office of the Bausch & Lomb Optical Co. is now located on the 35th floor of the RCA Building, 30 Rockefeller Plaza, New York City.

THE POLISH GLASS TRADE AND INDUSTRY IN 1935

By GEORGE R. CANTY*

THE Polish glass trade and industry suffered a serious setback during 1935. The three leading negative factors were the increase in imports of raw, and finished products, a substantial decline in practically all glass products exported, and the price fall on the domestic and foreign markets.

A great lack of chipped and reclaimed glass for resmelting purposes, and the new import quotas allotted Germany on finished glass products, augmented imports considerably, thereby effecting a sharp decline in prices on the local market. At the same time, the expiration in March, 1935 of the agreement between hand and machine producing manufacturers of glass, forced prices still lower, even below production costs. Consequently many hand-producing units were forced to shut down indefinitely. This occurrence may, however, lead to an improvement in the glass industry inasmuch as the industry is unquestionably top heavy from too many factories in operation.

Exports declined chiefly as a result of very low prices and the introduction of sharp import restrictions abroad, coupled with high transportation costs in Poland.

In spite of increased imports of certain finished glass products, production in the Polish glass industry during 1935 rose slightly above the 1934 volume, from 97,189 tons valued at 54,473,000 zlotys (*one zloty equals* $0.188) to 97,809 tons valued at 48,928,000 zlotys, an increase of 0.63 per cent in volume but a decline of 10.1 per cent in value. Several new articles were introduced in production such as nursery bottles, glass coffee percolators, heat resistant glass for cooking utensils, which replaced products formerly imported. Considerable improvement was also made in the production of glass wool.

The following table shows production in the different branches of the industry in 1934 and 1935:

	1934		1933	
Product	*Weight in metric tons*	*Value in 1,000 zlotys*	*Weight in metric tons*	*Value in 1,000 zlotys*
Porcelain tableware	2,337	5,708	2,805	6,174
Glass for electrical purposes	952	1,578	1,191	1,839
Plate glass	24,273	10,091	26,093	9,008
Bottle glass	59,028	27,781	58,760	24,162
Table and sundry glassware	10,599	9,578	8,960	7,753
Totals:	97,189	54,473	97,809	48,928

Owing to renewed activity in the building trades, production of both plate glass and glass for electrical insulation increased substantially and offset the declines registered in the output of bottle, table, and sundry glassware. Plate glass increased by 6.9 per cent in volume, but declined by 12.02 per cent in value. The decline in value was the direct result of increased imports of window plate glass from Germany on an already well supplied domestic market by Polish producers. Glass for electrical purposes and porcelain tableware, however, showed satisfactory gains, the former by 20 per cent in volume and 14.1 per cent in value, and the latter by 20 and 8.1 per cent in volume and value, respectively. Bottle glass declined by 0.5 per cent in volume and 13.02 per cent in value. The decline in volume is attributed to the new practice instituted by the Alcohol Monopoly of buying back its old bottles for further use. As a whole, the industry operated in 1935 at about 40 to 50 per cent of capacity. Of the 128 Polish factories, only 61 were engaged in production but this was frequently interrupted by shut-downs or lay-offs of workers.

The total volume of domestic sales of glass products declined from 96,019 tons valued at 54,401,000 zlotys in 1934 to 92,358 tons valued at 46,977,000 zlotys during 1935, or by 3.8 per cent in volume and 13.6 per cent in value. Of the various glass products listed below only porcelain tableware and glass for electrical purposes registered any appreciable gains:

	1934		1935	
Product	*Weight in metric tons*	*Value in 1,000 zlotys*	*Weight in metric tons*	*Value in 1,000 zlotys*
Porcelain tableware	2,271	5,532	2,628	5,815
Glass for electrical purposes	1,017	1,676	1,196	1,829
Plate glass	25,244	10,654	22,869	7,958
Bottle glass	57,257	27,208	56,197	23,197
Table and sundry glassware	10,230	9,331	9,468	8,178
Totals:	96,019	54,401	92,358	46,977

As a result of heavy dealer stocks, plus a saturated market, sales of plate glass declined by 10.3 per cent in volume, while reduced orders from the State Alcohol Monopoly were responsible for the 1.8 per cent volume decline of bottle glass.

EXPORTS of Polish glass products declined from 907.8 tons valued at 1,114,000 zlotys in 1934 to 615 tons value at 789,000 zlotys in 1935, or by 32.2 and 29.2 per cent, respectively. The chief factors responsible for the decline were the development of domestic glass industries where Polish glass products found a temporary market, as in Palestine and Egypt; the introduction of more rigorous import restrictions abroad, and the high cost of transportation in Poland. A further decline in exports may be expected as the newly revised freight tariffs on the Polish State Railways, effective March 15, 1936, accord no favorable consideration to the Polish glass industry. Of the products exported, all registered considerable declines, excepting decorated glassware, which, due to resumed or larger exports to England, France, and the United States, increased from 32.2 tons valued at 61,000 zlotys in 1934 to 73.5 tons, valued at 135,000 zlotys in 1935, or increases of 128.3 and 121.4 per cent in volume and value, respectively.

The following table shows Polish exports:

White Glass Pressed, Blown.

	1934		1935	
Country	*Weight in metric tons*	*Value in 1,000 zlotys*	*Weight in metric tons*	*Value in 1,000 zlotys*
Austria	2.7	3	..	..
Egypt	90.3	137	4.8	6
Great Britain	64.7	99	58.5	120
Italy	35.4	61	11.3	17
Palestine	73.4	94	60.0	66
United States	...	...	12.9	33
Other Countries	171.7	255	90.8	145
Totals:	438.2	649	238.3	387

* This paper by the American Commercial attache at Warsaw was released through the courtesy of the U. S. Bureau of Foreign and Domestic Commerce.

Exports of Plain White Glassware

Country	1934 Weight in metric tons	1934 Value in 1,000 zlotys	1935 Weight in metric tons	1935 Value in 1,000 zlotys
France	7.7	8	..	..
Great Britain	..	..	18.8	30
Netherlands	5.2	21	..	..
Palestine	7.2	10	9.7	16
United States	21.7	65	1.2	4
Other Countries	23.8	54	21.5	32
Totals:	76.6	158	51.2	82

Decorated Glassware

France	4.1	6	33.8	64
Great Britain	..	..	14.3	27
United States	2.0	9	5.8	12
Other Countries	26.1	46	19.6	32
Totals:	32.2	61	73.5	135

Plate Glass

Austria	..	..	36.2	8
Egypt	23.8	13	10.8	3
Palestine	38.2	14	39.8	21
Other Countries	115.5	37	0.4	2
Totals:	177.5	64	87.2	34

Sundry Glassware

Country	1934 Weight in metric tons	1934 Value in 1,000 zlotys	1935 Weight in metric tons	1935 Value in 1,000 zlotys
Other Countries	183.3	182	164.8	151
Grand Totals:	907.8	1,114	615.0	789

Imports of Glass Products Rise

IMPORTS of various raw and finished glass products continued to rise during 1935 despite a saturated domestic market, although local production, which maintained itself more or less on the same level of the previous year, only operated at from 40 to 50 per cent of its capacity on account of depressed economic conditions generally, but in the domestic glass industry in particular. Imports of glass increased considerably from 4,759 tons, valued at 2,928,000 zlotys in 1934, to 5,760.1 tons, valued at 3,429,000 zlotys in 1935, or by 21.03 and 17.1 per cent, respectively. The bulk of imports constituted chipped and pulverized glass which were chiefly used as a raw material for the domestic manufacture of glass. The leading supplying countries of this product were Austria, Czechoslovakia, and Germany. Moreover, as a result of the Polish-German trade agreement of Nov. 4, 1935, Germany was allotted a Polish import quota, which helped largely to increase the volume of raw and finished glass products.

The following table shows imports of various glass products, by countries of origin, during 1934 and 1935:

Chipped and Pulverized Glass

Country	1934 Weight in metric tons	1934 Value in 1,000 zlotys	1935 Weight in metric tons	1935 Value in 1,000 zlotys
Austria	1,436.2	45	629.9	29
Czechoslovakia	56.8	72	1,232.1	235
Germany	1,262.6	240	1,714.6	199
Other Countries	607.5	66	616.3	176
Totals:	3,363.8	423	4,219.9	639

White, Semi-white, Pressed, Molded Glass

Austria	20.3	58	49.9	181
Czechoslovakia	36.7	115	41.4	100
Germany	14.5	47	87.5	298
Italy	2.2	8	1.0	3
Netherlands	44.9	168	11.1	43
Other Countries	9.3	36	10.6	37
Totals:	127.9	432	201.5	662

Plate Glass Not Polished

Belgium	260.2	226	230.0	155
Czechoslovakia	392.5	250	496.5	338
Other Countries	31.1	46	4.6	17
Totals:	683.8	522	731.1	510

Plate Glass, Polished

Country	1934 Weight in metric tons	1934 Value in 1,000 zlotys	1935 Weight in metric tons	1935 Value in 1,000 zlotys
Belgium	22.9	36	18.8	21
Czechoslovakia	66.2	81	45.0	43
Other Countries	6.4	14	0.5	3
Totals:	95.5	131	64.3	67

Mirror Glass, Ground, Opaque

Belgium	158.6	275	180.9	277
Czechoslovakia	202.6	338	182.8	261
Other Countries	0.5	1	30.1	32
Totals:	361.7	614	393.8	570

Sundry Glassware

Other Countries	126.3	806	149.5	981
Grand Totals:	4,759.0	2,928	5,760.1	3,429

The number of workmen employed by the glass industry increased from 10,903 to 11,605. This increase was caused by the introduction of shorter working time per workman, plus a compulsory furlough system.

6,700,000 HOMES WANTED

Manufacturers of glass for housing purposes will be interested in the findings of W. C. Bober, head of the Johns-Manville statistical research department as printed in their house organ, *Power Specialist*. Estimating that 4,000,000 people reached the marriageable age during 1926 to 1935, Mr. Bober figured that this created a need for 3,500,000 homes.

Fire and other natural calamities destroyed about 700,000 homes which brings the total to 4,200,000 and only 3,000,000 homes have been built since 1926 to take care of this need. The Real Property Inventory reveals that deterioration has made 2.2 per cent or 682,000 of the dwelling units unfit for human habitation. In addition, 4,774,000, or 15.4 per cent of the home units, require major structural changes which amount to rebuilding.

Statistically minded glass men will see from this that there is a definite need for some 6,700,000 new and rebuilt homes in this country. Obviously, here is something worth looking into.

Announcement of the appointment of Alfred C. Schwartz as Eastern sales representative has been made by the Glenshaw Glass Co., Glenshaw, Pa. Mr. Schwartz, who succeeds the late Charles E. Gray, will make his headquarters in the Flatiron Building, 175 Fifth Ave., New York.

Can you use an unskilled laborer with the following qualifications: Age 23, strong, robust constitution. Aggressive personality, single. Graduate of a leading ceramic college. Wages and hours no object. My desire is to learn the practical side of glass making from the ground up and will consider it a privilege to push wheelbarrows or do any and every kind of job you have to offer. Address Box 28, THE GLASS INDUSTRY.

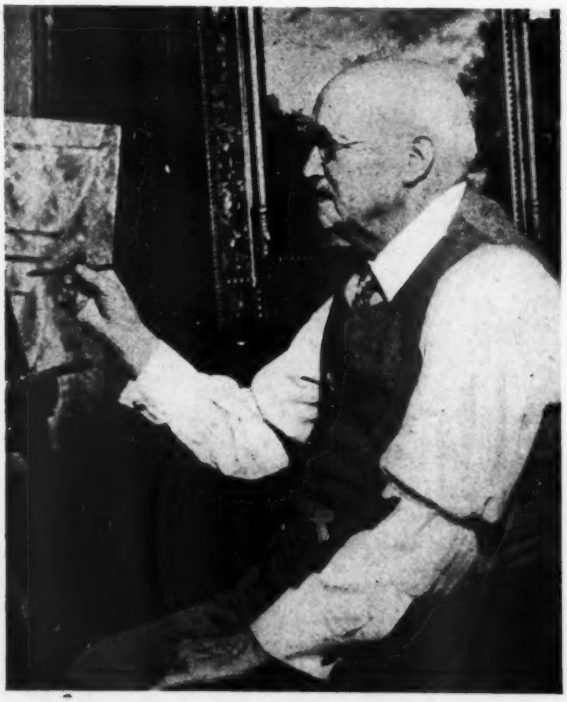
JOSEPH LOCKE, ARTIST

By ALEXANDER SILVERMAN[1]

**Head of the Department of Chemistry,
University of Pittsburgh**

Joseph Locke, who died recently in Pittsburgh, was a master etcher, engraver, and scultpor in glass. Dr. Alexander Silverman, Head of the Department of Chemistry in the University of Pittsburgh, had the good fortune to meet Mr. Locke and view some of his finest work some years before his death. Dr. Silverman has interviewed the children and has had full access to the collection which Mr. Locke left in their care. On the strength of his personal contact with the artist and with his children, he has prepared the biographical sketch which follows.—The Editor.

AS YOU cross the Monongahela River from the Twenty-second Street Bridge and look right and left, Pittsburgh's industry is in evidence through the smoke and flame from the mills. Glancing up at the South Hills, you see a clear sky and sunshine, and as you drive up through the winding roads, making one intricate turn after another, you finally come to a little street which is known as Carl Street on Mount Oliver. Even if you did not know the number 442, you could locate the late Joseph Locke's residence by the large monogram, "J-L" which is etched on the plate glass panels of the doors. The symbol of the artist's prime interest is in evidence at the very entrance to his studio, which was located in the rooms of the ground floor of the residence, a place never disturbed by his family which resided on the upper floors. On the rear of the lot is a long, narrow, one-story brick building, his third Pittsburgh shop, which has already crumbled to the danger point and in which Joseph Locke stored his blanks, prepared his resists, coated and designed his ware, and etched and engraved. In his earlier years he conducted an appreciable business in etching to order for glass and china shops, and for private homes. His finest work he prized so highly that he rarely sold an article. He would, occasionally, present one to a friend or to some individual whom he met who made a special appeal.



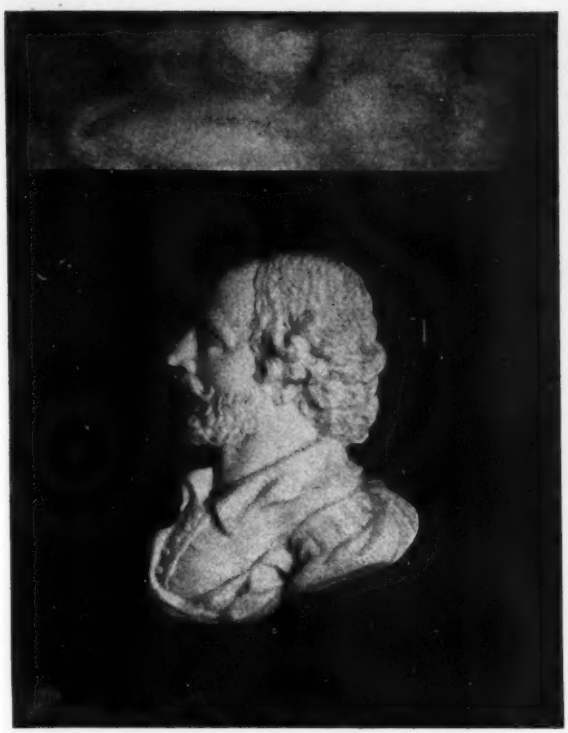
Joseph Locke on his eightieth birthday.

Joseph Locke was born in Worcester, England, August 21, 1846. He was the son of Edward Locke, a potter, and was one of two childen by a second marriage to a Miss King. The father and mother died when Joseph was a child, and he and his brother Thomas were reared by two children of the first marriage, Edward Locke and a Mrs. Paine. Edward Locke was a designer and decorator in the Royal Worcester China Factory to which Joseph Locke was apprenticed when only twelve years of age. According to stories related by Joseph Locke to his children, apprentices were instructed at various times by the leading painters of England, who were engaged for that purpose by the company.

When Joseph was nineteen, Guest Brothers, etchers and decorators of glass in Stourbridge, advertised that there would be a prize competition for designs for a fireplace which was to be built in the palace of the Czar of Russia. Young Locke, who was still under apprenticeship in the Royal Worcester plant, won the competition, "jumped" his apprenticeship, and went to Stourbridge. On the completion and exhibition of the designs, the Royal Worcester Company learned the whereabouts of their apprentice and made efforts to insure his return, as he was still under age. They later displayed better judgment and decided that they could gain more by leading the china world to believe that the fireplace had been designed by one of their staff.

During his painting of the fireplace designs, Joseph Locke became interested in glass, its decoration and etching, and was retained by Guest Brothers. There he developed the first stages of his art. His drawings were always free hand, on a resist which he modified to suit his needs and on which he experimented to his last days. He worked with bees' wax, paraffin, stearin, mutton fat, with various solvents and gums, according to the problem on hand and to meet the weather conditions of the moment. He used steel needles and other implements, as well as orange wood and other especially chosen devices which would enable him to produce effects from the finest line to the broadest band. He frequently applied a thickened acid with a brush to fill in the spaces between deep-line etching and after the final melting off of the resist he would engrave or polish the matt surface to produce the lights and shadows. He knew that highly concentrated hydrofluoric acid would produce deep, bright etchings and that the addition of ammonium carbonate and various salts resulted in gradations from the bright through the satin to a

[1]Contribution No. 320 from the Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania.



Bust of Shakespeare sculptured and engraved by Joseph Locke.

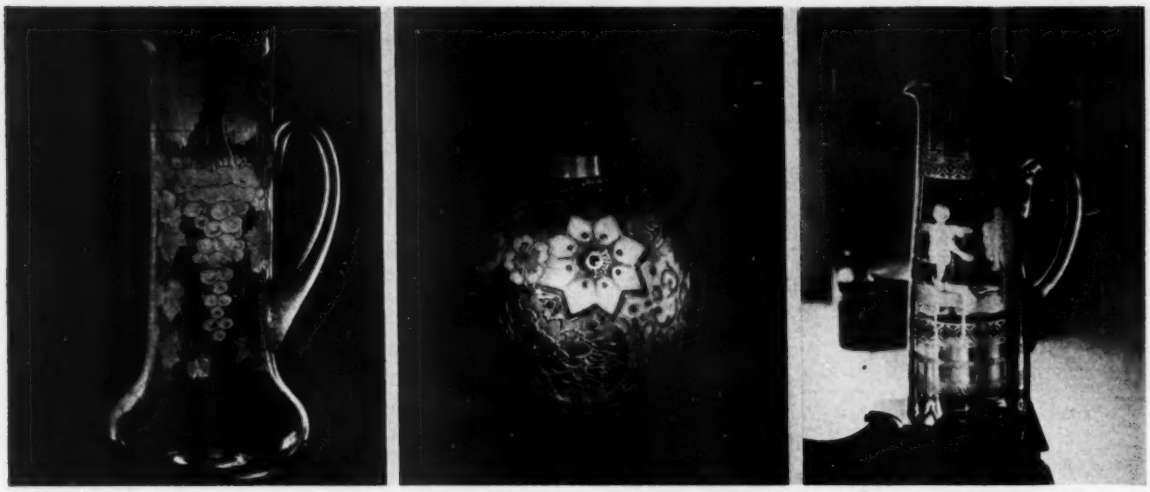
dense matt etch. He was aware that barium sulfate could be employed to thicken the mass for painting, and that glue and starch would also serve this purpose. The late Mrs. Locke often commented that her corn starch supply in the kitchen was a very uncertain one, because of Mr. Locke's depredations.

Knowing that their young artist wished to locate in Stourbridge, Guest Brothers decided to make him comfortable by suggesting that he lodge with a maiden aunt of theirs, a Miss Jane Guest. Miss Guest was the sister of a Mrs. Philip Drewry, also of Stourbridge, with whose daughter Joseph soon became infatuated and whom he married later. At this time, Locke was a famous local runner, and through his sprinting, he developed a friendship with a Mr. Hodgetts of the firm of Hodgetts and Richardson, located in Wordsley, a suburb of Stourbridge. Hodgetts suggested that Locke join his firm and start an etching and decorating plant. This he did to the displeasure of Guest Brothers, who thought that after marrying into the family it was his duty to stay with them. It is said that there was quite a "heated family conclave, which was settled, according to Mrs. Locke, by the fact that he was a married man and needed more money than Guest Brothers wanted to pay"; and so, he entered upon his new venture with a prophecy of failure from the disgruntled Guest Brothers.

Hodgetts and Richardson became leaders in etched and engraved glass. While there, Mr. Locke developed the art of cameo cutting and engraving upon a glass of two or more layers of different color. Through this treatment an intaglio effect was produced. While etching was not known in Rome at the beginning of the Christian era when the famous Barberini or Portland vase was produced, probably through engraving and sculpture alone, Locke had the advantage of outlining his figures in the simpler fashion through etching. The Wedgewood factory at Stoke was already selling reproductions of this vase. It will be recalled that Josiah Wedgewood made black and white pottery reproductions during the latter years of the eighteenth century and that his third model was pronounced perfect by the eminent artist, Sir Joshua Reynolds. One of the accompanying illustrations is a reproduction of the card of admission to see Josiah Wedgewood's model. It indicates the high appraisal of the reproduction in pottery.

It might be well to say just a word about this most famous cameo of all time, before continuing with Mr. Locke's work. The Barberini vase was discovered under a mound of earth near Rome about 1630. Under instruction of Pope Urban VIII it was removed to the Barberini Palace in Rome where it remained until 1776. Then the Barberini family were compelled to sell some of their treasures and the vase was acquired by Sir William Hamilton, who in turn sold it to Margaret Cavendish, the Duchess of Portland, for about two thousand pounds. Although she disposed of many of her treasures in time, the vase came into the hands of her son, the third Duke of Portland. It was placed in the British Museum in 1810, but did not become generally known until 1845 when a demented individual deliberately smashed it by throwing a stone through the case. It was repaired and remained on exhibition in the Gold Room of the British Museum for one hundred and nineteen years. Some will recall that on May 2, 1929, it was placed on auction by Christie's in London, where an offer of $143,000 was refused. For some time thereafter the vase was missing from its place in the Gold Room, but it is again on exhibition in the British Museum. The background is a dark blue glass, almost black in appearance, and the cameo reliefs are on a dense white opal.

We now resume with Mr. Locke's work on the reproduction of the Portland vase in glass. Hodgetts and Richardson were exibiting in the Paris Exposition about 1877 or 1878 and wanted something of a superlative nature for this exhibit. The idea of reproducing the Portland vase in glass occurred to them. While is was not known with whom this idea originated, Joseph Locke was fired with enthusiasm. The glass blowers made thirty or forty blanks which were blown and finished, for they knew that many of them would "fly" at the uneven expansion of the layers. The blanks were put aside for weeks after most careful annealing, but flew to pieces one after another until only two remained. The Paris Exhibition was to open in six months and the etching, engraving, and sculpturing had to be complete. Which of the two blanks was to be employed? The flip of a coin determined the choice. Locke started to work, but after three weeks this blank also broke. He immediately started on the one remaining blank, which could not be completely entirely, but which in its nearly complete state won the gold medal for Hodgetts, Richardson, and Company. Although the gold medal of the Paris Exposition remained with the Company, Locke was awarded a "Prize Medal" in bronze by the Glass Seller's Company in connection with an exhibition held in 1876. The purpose of the award is not indicated on the medal. The vase was never finished, for Mr. Locke left Hodgetts and Richardson some time after, through a disagreement. It is said that Mr. Locke returned to Eng-



Left: Etching and shadow engraving by Joseph Locke; center: a pink opal glass bottle etched, engraved and enameled by the artist; right: a mythological etching on amberina glass by Joseph Locke

land twenty years later and offered to purchase the vase at any price which the company would place upon it. He was unsuccessful. It was exhibited by the company for a number of years in various British cities and is now said to rest in one of the London museums. The writer has, unfortunately, not been able to locate it, nor has he seen it in the various museums which he has visited in London.

From Hodgetts, Richardson and Company Mr. Locke went to Pargeter and Company, another glass firm, but he did not get along with Mr. Pargeter and soon left to join Thomas Webb and Corbett. His son Edward, an author, of East Islip, Long Island, states that he joined his father when only twelve years of age in the Pargeter plant and operated the etching machine, later going with him to Webb and Corbett. It seems that progress there was not to Joseph Locke's liking and, as he was receiving invitations to come to America, he decided upon this venture. The Boston and Sandwich Company, concerning which five articles appeared during the current year in this periodical[2] had offered him a position in Sandwich on Cape Cod. When they heard that he was sailing, they sent a representative to New York to meet him, but he landed in Boston. The New England Glass Company, learning of this, sent their representative to the boat and signed him up before the Boston and Sandwich Company could get a hold. He was in America less than a year when, in 1884, he sent to England "for the brood." Edward Locke, who is responsible for much of the information contained in this article, recalls the whole family except his sister Nora being driven to Dudley, with a wagon load of house furnishings, under the supervision of Grandpa Drewry, who next accompanied them to Liverpool, where they sailed on the Marathon, a Cunarder, in two cabins, as first class passengers. They landed in Boston in midwinter after fourteen days.

Shortly after his connection with the New England Glass Company in East Cambridge, Massachusetts, Joseph Locke patented his "Amberina" art glass which was made by heat treating a special gold glass to which he added a yellow coloring agent. With heat treatment the glass struck red, and by proper manipulation the ruby color gradually blended into yellowish amber. He also developed "Pomona" art glass through a combination of etching and staining. He was the first to frost incandescent lamp bulbs, and designed some carbon filament lamps for which sketches exist among his papers. It is unfortunate that a fire in his first shop on Carl Street, Pittsburgh, Pennsylvania, about thirty years ago destroyed the shop and most of his records, with the consequence that formulas for his resists, etching fluids, glass batches, etc., have been lost. He seems never to have recorded his recollections of these after the fire.

The New England Glass Company was owned by William L. Libbey and his son Edward. When they decided to move to Toledo, Ohio, to take advantage of natural gas, the firm of Libbey, Richardson, and Locke was established. This Richardson was not related to the Richardsons of England. The name Libbey has always been synonymous with the finest of etched and engraved ware. Mr. Locke remained in Toledo for several years and then decided to start a business of his own, coming to Pittsburgh in 1888, where he located on Keller Street, in Old Birmingham. He was a poor business manager and after floundering a while accepted an invitation from Daniel Ripley, President of a newly formed glass combine, the United States Glass Company, as head designer and consultant. While with this company he developed his wire glass. The glass contained a wire mesh like chicken wire, in which the wires were covered with asbestos. It is said that he sold this invention and obtained a sufficient return to enable him to retire from employment with others and devote the remainder of his life to his work of love, etching, engraving, sculpturing, painting. The writer has some specimens of an old wire glass which perfectly fits the description of Mr. Locke's invention. It is known as "Besto" glass and was manufactured by the Davis Glass Company of Pittsburgh. The label contains the following comments: "Makes Fireproof Shutters—Machine Shop, Storage, Warehouse, and Cellar Windows—

[2]A. Silverman, SANDWICH GLASS: I. Introduction. Crystal Batches, The Glass Industry, **17**, 50 (1936); II. Opal and Alabaster Glasses, ibid, **17**, 93 (1936); III. Red and Pink Glasses, ibid, **17**, 127 (1936); IV. Ambers, Yellows and Greens, ibid, **17**, 167 (1936); V. Blue, Lavender, Gray and Black Glasses, ibid, **17**, 205 (1936).

Skylights—Side-walk Awnings. Should be used in all exposed places." The specimens are identical with some of Mr. Locke's original glass which was in the possession of one of his daughters.

Mr. Locke's outstanding accomplishment was an engraved and sculptured head of William Shakespeare, about one and a half by two inches in a dense white glass which is mounted on a rectangular plate of gold ruby about three inches by four inches. While the writer has never seen Mr. Locke's reproduction of the Portland vase in glass, he can say without hesitation that the Shakespeare head is the most superb bit of sculpture and engraving that he has ever seen in glass.

U. S. PATENTS ISSUED TO JOSEPH LOCKE

No. 282,002—Amberina Glass—July 24, 1883.
No. 283,625—Indenting Convex Surfaces—August 21, 1883.
No. 288,582—Amberina Glass—November 13, 1883.
Reissue No. 10,446—Striking Glass For Color Variation—February 5, 1884.
No. 316,469—Electrical Insulator—April 28, 1885. (With William Bowker).
No. 316,551—Selectively Staining Etched Ware—April 28, 1885.
No. 343,961—Stippled Etching—June 15, 1886.
No. 345,436—Partial Casing—July 13, 1886.
No. 349,228—Apparatus for Making and Burning Gaseous Fuel—September 14, 1886. (With Solon O. Richardson, Jr.).
No. 356,409—Metallizing and Staining—January 18, 1887.
No. 371,956—Apparatus for Making and Burning Gaseous Fuel—October 25, 1887. (With Solon O. Richardson, Jr.).
No. 403,434—Apparatus for Making and Burning Gaseous Fuel—May 14, 1889. (With Solon O. Richardson, Jr.).
No. 524,936—Asbestos-Covered-Wire Glass—August 21, 1894. (With John H. Croskey).
No. 528,080—Glass Press—October 23, 1894. (With John H. Croskey).
No. 528,081—Manufacture of Hollow Ware—October 23, 1894. (With John H. Croskey).
No. 530,399—Electric Insulator—December 4, 1894. (With John H. Croskey).
No. 530,825—Method and Apparatus for Pressing Glass—December 11, 1894. (With John H. Croskey).
No. 540,540—Underground Electrical Conductor—June 4, 1895. (With John H. Croskey).
No. 548,520—Asbestos-Covered-Wire Glass—October 22, 1895. (With John H. Croskey).
No. 568,298—Underground Conductor—September 22, 1896. (With John H. Croskey).

It clearly indicates that Joseph Locke was an artist of the highest type.

Mr. Locke frequently combined etching, sculpturing, and enamelling. A small vase, Persian in appearance, is another outstanding example of his art. He painted in water color and oil, still life, fruit and flowers, woodland scenes, etc. The home on Carl Street is full of his paintings. Alexander Robinson, the Boston art critic of fifty years ago, said "Joseph Locke's flowers excell any that I have ever seen. It would seem that you can smell their fragrance." Locke did copper and steel plate etchings and here again displayed superior craftsmanship and variety. Many of these etchings remain in the possession of his children.

But the work for which Joseph Locke was best known was his etching on glass. His flowers, his fruit, themes from fairy-land, especially Brer Fox and Brer Rabbit, mythological scenes like the characters from Wagner's operas, the friezes from the Lesbian Marbles, etc., and finally the portrayal of biblical characters, for example, Rebecca at the well, the Good Shepherd, etc. His interest in human action is shown in scenes from the hunt, and the etched plates of the Wagnerian heroes provided evidence of his love of music. After hearing Adelina Patti, he etched a plate of a young woman in formal evening dress holding a sheet of music. The etching is entitled "Encore." And so, one might go on endlessly enumerating and describing the handiwork of Joseph Locke.

Of the children of Joseph Locke and Louisa Drewry, nine came to America and one was born here. They are: Joseph Edward Philip, Helen Beatrice (Mrs. Coburn), Francis Harry, Walter King (Deceased), Anna May (Mrs. Voight), Dora (Deceased), Nora (Mrs. Williamson), Thomas Hubert, Edith Maude (Mrs. Romack), Herman Anderson. There are sixteen grandchildren and two great grandchildren.

After his retirement from the United States Glass Company, Mr. Locke confined himself to the etching of blanks for shops and in some instances for private families. The original design was always a free hand sketch of his own. If an entire service had to be prepared, he would cut copper stencils, which were applied by his daughter Anna May or his son Francis Harry. As he got older, Mr. Locke was more and more reluctant to commercialize his art, and he confined himself to original etchings on glass, table ware, pitchers, vases, and tiles of cased glass. Many of these are in the possession of Mrs. Nora Jane Williamson, who occupies the old residence, and there one sees the many examples of his versatility, etching, engraving, sculpturing, and enamelling on glass, the copper plate etchings, pen and ink sketches, oil and water color paintings. A small group of his outstanding works of art in glass is on exhibition in the Historical Society of Western Pennsylvania in Pittsburgh.

In the death of Joseph Locke on June 10, 1936, in his ninetieth year, America and the world have lost an outstanding artist and artisan. Potter, designer, etcher, sculptor, painter, inventor, his accomplishments embody the evolution from an apprentice, through the ranks, to a man of fame. The man, Joseph Locke, is no longer with us, but with the preservation of his works of art he will live forever.

Card of admission to see Josiah Wedgwood's original pottery reproduction of the Portland Vase.

REFRACTORIES DIVISION MEETING SEPT. 4-5

The Refractories Division will hold its Summer Meeting at Bedford Springs, Sept. 4 and 5. The technical session will be devoted to a discussion of Checker Brick and Regenerators. The program provides for golf, and other recreational activties. There will be a full program for the ladies. The meeting is scheduled for the week-end preceding Labor Day, so that those who wish to may extend their vacation by attending the meeting.

Two papers will feature the Technical Session:—

J. D. Keller, Research Engineer, Carnegie Institute of Technology, will speak on "The Influence of Material, Shape and Size of Checker Brick on Regenerator Performance." William C. Buell, Jr., Consulting Engineer, Cleveland, author of "The Open Hearth Furnace," will talk on "Performance of Checker Brick Under Various Operating Conditions." He will discuss abuses in the design of open hearth regenerators which affect the performance of checker brick.

Following is an outline of the program:

Thursday, September 3: Plant trips (optional).
Friday, September 4:
9.00 A.M. to 12 Noon. Registration, Bedford Springs Hotel.
12 Noon. Luncheon.
2:00 P.M. Technical Session in Auditorium.
2:00 P.M. Ladies Program: Bridge in the Colonnade, prizes.
6:30 P.M. Clay-workers Club Reception in Private Dining Room.
7:30 P.M. Banquet.
9:00 P.M. to 12 Midnight. Dancing, Ball Room.
Saturday, September 5:
9:00 A.M.
Men: Golf Tournament. Prizes for low gross score, kicker's handicap and high gross score (booby prize).
Ladies: Putting contest, prizes.
12 Noon. Luncheon.
2:00 P.M. Golf, swimming, etc.

GLASS DIVISION MEETING LATE

The Glass Division of the American Ceramic Society will probably hold its summer session late in October, according to word received from J. S. Gregorius, chairman of the Division. The program will more than likely be devoted to informal reports covering the International Glass Congress in London.

GLASS MEN AT CHEMISTRY UNION

Dr. Alexander Silverman of the Department of Chemistry, University of Pittsburgh, will attend the meeting of the International Union of Chemistry, Lucerne, Switzerland, August 16-22, as a delegate from the American Ceramic Society. He is also a delegate from the National Academy of Sciences and the National Research Council.

Dr. John C. Hostetter of the Corning Glass Works, who has been in England attending the Glass Congress, will also attend the meeting as a Councilor of the National Research Council, on which he is the representative of the American Ceramic Society.

PITTSBURGH PLATE FOUNDS FELLOWSHIP

The Pittsburgh Plate Glass Co. has founded a multiple industrial fellowship at the Mellon Institute of Industrial Research to study fundamental problems in the various fields covered by the activities of Pittsburgh Plate. This work will include basic studies in the technology of glass, heavy chemicals, paints, varnishes and lacquers. Senior incumbent of this fellowship is Dr. Frederick W. Adams who has been a member of the chemical engineering department at the Massachusetts Institute of Technology for the past 14 years.

ALFRED GRADUATES WIN JOBS

The employment situation is now better than it has been for several years. The names of graduates of the New York State College of Ceramics, Alfred, N. Y., who have recently obtained positions and their employers are as follows:

Ernest H. Spencer, Cerro de Pasco Copper Corp., Peru, South America; Donald Hayward, O. Hommel Co., Pittsburgh; Charles N. Jewart, Bethlehem Steel Co., Lackawanna, N. Y.; Elliott V. Haines, International Business Machines Co., Endicott, N. Y.; Edwin L. Phillips, O. Hommel Co., Pittsburgh, Pa; Harold Prior, Titanium Alloy Mfg. Co., Niagara Falls, N. Y.; Hurd Safford, Fellowship at University of Pittsburgh; Stuart Schatz, Laclede Christy Clay Products Co., St. Louis, Mo.; Morris Corbman, Binghamton Brick Co., Binghamton, N. Y.; Armand Houze, Convex Glass Co., Point Marion, Pa.; Eric Loytty, Corning Glass Works, Corning, N. Y.; A. Curtis Jackson, The Claycraft Corp., Columbus, Ohio; John Besley, Standard Gas Equipment Co., Baltimore, Md.; Eugene Crandall, Mullite Refractories, Shelton, Conn.; Alfred Titsworth, Iroquois China Co., Syracuse, N. Y.; Lee M. Hedges, Johns-Manville Co., Manville, N. J.; Ludwig Vogel, Crown Cork and Seal Co., Baltimore, Md.; Louis Schiffner, Inland Glass Co., Chicago; John Nevius, Bausch and Lomb Optical Co., Rochester, N. Y.; T. E. Engelder, Phoenix Glass Co., Jeanette, Pa.; Robert Cooley, Jr., Electrical Porcelain Co., Lima, Ohio; Phillip Bennett, Standard Sanitary Co., Trenton, N. J.; Charles Evans, W. A. Case and Sons, Mfg. Co., Robinson, Ill.; Arthur Gibbons, Bayridge Novelty Co., Trenton, N. J.; Andrew J. Fedor, New Jersey Zinc Co., Franklin, N. J.

PLATE GLASS PRODUCTION IS UP

A total of 102,080,318 square feet of plate glass was produced by member companies of the Plate Glass Manufacturers of America during the first six months of 1936 as compared to 88,363,275 square feet produced during the same period in 1935. The June production was 16,243,665 square feet as compared to 19,192,144 square feet produced in May and 13,162,515 square feet produced in the corresponding month last year.

"FOOTE PRINTS" FEATURES ZIRCON

The June issue of *Foote Prints*, the semi-annual journal, published by the Foote Mineral Co., Philadelphia, contains an interesting article on zircon. Its history, properties, origin and mode of occurrence are briefly described and data concerning the various workable deposits is given. Typical chemical analyses of the zircon obtained from these deposits is also included. *Foote Prints* also contains several pages of analysis and specifications of the various chemicals, metals, alloys and ores manufactured by the company.

The latest patents of inventors from a score of countries will be a feature of the Leipzig Fair to be held in Leipzig, Germany, Aug. 30 to Sept. 3. The advice of experts will be available for developing new ideas and the proper procedure for gaining patents and protecting inventions in various countries.

HEAT ABSORBING GLASSES

The purpose of a heat absorbing glass* is to diminish the heat entering the room glazed with it either as a window or as a roof light. The energy which is absorbed by the glass causes its temperature to rise, and since this heat must be dissipated by re-radiations and convection, it has been suggested from time to time that the ultimate result of using a heat absorbing glass is the same as using an ordinary transparent glass. The argument is that whereas the heat passes unobstructed through the ordinary glass it is used for raising the temperature of the heat absorbing glass, which itself loses its heat to the surrounding air by convection, and also re-radiates into the room, so that ultimately the heat from the outside source is used in warming the room. This simple argument is, however, fallacious and a nearer approximation to the true state of affairs is given by the following discussion.

Considering first the case of ordinary roofing glass which has a total energy transmission of approximately 80 per cent, then if the incident radiation on the window is considered as 100, about 8 per cent is reflected back from the surface of the glass and 80 per cent of the energy falling on the glass is directly transmitted into the room. Thus, there is 12 per cent absorbed by the glass and which is used in raising the temperature of the glass. This rise of temperature of the glass continues to such a point that the energy lost by re-radiation and convection is equal to the energy absorbed, and since the temperature gradient through a piece of glass $\frac{1}{8}$ in. to $\frac{1}{4}$ in. thick is very small, the inside and outside temperatures are sensibly the same. In this way approximately half of this 12 per cent is dissipated outside the room and half inside. The total energy, therefore, getting into the room for the ordinary rolled plate in the complete absence of ventilation is 86 per cent of the incident energy. It should also be remembered that the solar radiation which passes unabsorbed through the glass is finally absorbed by the walls and floor of the room causing the temperature of these surfaces to rise and hence the surfaces themselves to re-radiate heat. Since, however, such radiation as is emitted by the slightly warm floor and walls is of very long wave-length, the window itself is completely opaque to it and this re-radiated energy cannot escape from the room. Thus, an unventilated room glazed with ordinary glass is a very efficient heat trap, which is, of course, the principle underlying the use of a greenhouse.

Considering now the case when the window is glazed with a particular heat absorbing glass, only about 20 per cent of the incident energy is transmitted directly, to be absorbed by the floor and walls, 8 per cent is reflected back at the window, leaving 72 per cent to be absorbed and dissipated from the glass itself. Again approximately half this heat is dissipated outside the room and half inside, making the total energy transmitted to the unventilated room 56 per cent of the incident radiation. Thus in the worst case, i.e., when the room is completely without ventilation, with a heat absorbing glass 56 per cent of the energy gets into the room and in ordinary rolled plate 86 per cent.

*From "The Efficiency of Heat Absorbing Glasses", by W. M. Hampton, Sands, Clays & Minerals, Vol. II, No. 4, April, 1936.

Normally, however, the difference is even greater than this in favor of the heat absorbing glass, since the external air is seldom stationary and convection increases very rapidly with the velocity of the air moving against the window. If, therefore, there is any wind outside the building more heat is dissipated outside the window than inside the room, which tends to increase the difference between the two types of glass. When, however, the building is properly designed for the use of a heat absorbing glass, arrangements are made immediately above the window for the escape of the heated air, which rises by convection from a hot surface. Again, to a rough approximation, half the heat lost from a surface only slightly higher in temperature than its surroundings, is lost by re-radiation and half by convection. Thus, if the convected heat is removed by ventilation and not allowed to enter the room, the figures for the percentage heat input into the room become:—

In the case of rolled plate 83%
For the heat absorbing glass 38%

thus increasing very substantially the advantage to be obtained from the use of a heat absorbing glass.

Another argument that has been advanced against the use of the inevitably more expensive special heat absorbing glass, is that reduction of the heating effect could be more cheaply obtained by reducing the area of the ordinary glass instead of using the special glass. This argument overlooks the fact that it is always desirable to distribute the light well about the working space, and an argument could be put up for the use of a greater use of window space on this ground alone, provided such an increase did not unduly affect the temperature of the room. A well designed building needs more rather than less window space and this can only satisfactorily be achieved by the use of this special glass.

The final test of any such glass is, of course, the opinion of the user and it can be stated without fear of contradiction that the use of glasses of this type has made possible work under tropical conditions where otherwise such work would have been impossible.

Figures have been published for the floor temperatures for no glass, ordinary glass, and for heat absorbing glass. It was found that when the shade temperature was 85.5°F the floor temperatures were:—

135°F with no glass.
124°F with ordinary glass.
98°F with heat absorbing glass.

This lower temperature of the floor has been suggested as contributing very largely to greater comfort.

To summarize the position, the use of these special heat absorbing glasses of high light transmission provides a means of locating the effective source of heat at the window where by appropriate ventilation its effect may be controlled; ordinary window glass allows the heat to pass directly to the floor and walls of the room and no control is possible.

Three historical documents dealing with American Revolutionary days have been placed under glass to keep them from deteriorating from the effects of sunlight or artificial illumination. The glass was developed in the laboratories of the Pittsburgh Glass Institute.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.15
52% and 48%	lb.	.10	.12½-.11½
Nitric (HNO_3) 130 lb. carboy ext. Per 100 lb.		...	5.50
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	...	Po. or Gr. .25 / Cry. .25½
Aluminum hydrate ($Al(OH)_3$)	lb.	.04-.04½	.04½-.05
Aluminum oxide (Al_2O_3)	lb.	.04	.05
Ammonium bicarbonate (f.o.b. works)	lb.	.0515	...
(f.o.b. N. Y.)	lb.	...	.0571
Ammonium bifluoride (NH_4FHF)	lb.	...	.14½
Ammonium nitrate (NH_4NO_3)	lb.	...	.08
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimonate of Sodium	lb.	.12	.12
Antimony oxide (Sb_2O_3)	lb.	...	.12¾
Antimony sulphide (Sb_2S_3)	lb.	...	.13
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04-.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	40.00	45.00
90% through 100 mesh	ton	38.00	...
Barium hydrate ($Ba(OH)_2$)	lb.	.0475	.05½
Barium nitrate ($Ba(NO_3)_2$)	lb.	...	.07¾
Barium selenite ($BaSeO_3$)	lb.	...	1.50-1.75
(Commercial, 25% Selenium)	lb.	...	.90
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash	lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.022	.0245-.027
Powdered	In bags, lb.	.0245	.027-.0295
Boric acid (H_3BO_3) granulated	In bags, lb.	.05	.0525-.055
Cadmium sulphide (CdS)—	lb.	...	.90-.95
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Chromite	lb.	...	.0215
Cerium hydrate 100 lb. drums and 600 lb. barrels	lb.	...	.65
Chrome Oxide Green, 400 lb. bbls.	lb.	.17	.215-.25
Cobalt oxide (Co_3O_4) In bbls.	lb	...	1.41
In 10 lb. tins	lb.	...	1.51
Copper oxide Red (Cu_2O)	lb.	...	.20
Black (CuO)	lb.	...	.15
Black prepared	lb.	...	.22
Cryolite (Na_3AlF_6) Natural Greenland (Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	.08½	.09
Feldspar— 20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%) Bulk, carloads, f. o. b. mines	ton	31.50	...
In bags	ton	33.10	38.00-40.60
Formaldehyde, bbls.	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide— Red (Fe_2O_3)	lb.	...	.0425
Black (Fe_3O_4)	lb.	.04½	...
Iron chromate	lb.	...	.035-.05
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolith)			
Lead chromate ($PbCrO_4$)	lb.	...	.16
Lead oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0710	...
In 5 Ton lots	lb.	...	.075
Less than 5 Tons	lb.	...	.08
Lime— Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	...
Burnt (CaO) ground, in bulk	ton	7.00	...
Burnt, ground, in paper sacks	ton	9.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.25	2.25
Limestone ($CaCO_3$)	ton	1.75	...
Litharge (PbO) (New York Prices)	lb.	.0610	...
In 5 Ton lots	lb.		.065
Less than 5 Tons	lb.		.07
Magnesium carbonate ($MgCO_3$)	lb.	.0610	.08-.09
Magnesium sulphate (U.S.P.)	lb.	...	.0265
Manganese, Black Oxide In Paper bags	ton	47.50	52.50-55.00
In Burlap bags	ton	51.50	54.00-56.50
In Casks	ton	53.00	55.50-58.00
Neodymidm oxalate, 50 lb. drums	lb.	...	5.00
Nickel oxide (Ni_2O_3), black	lb.	...	.35-.40
Nickel monoxide (NiO), green	lb.	...	.35-.40
Plaster of Paris, bags	ton	31.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)— Crystals	lb.	...	.09
Powdered	lb.	...	.09½
Potassium carbonate Calcined (K_2CO_3) 96-98%	lb.	.06¾	.07½
Hydrated 80-85%	lb.	.06	.06¼-.06½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	...	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.06¼-.06½	.08-.08½
Potassium nitrate (KNO_3) (gran.)	lb.	.0545	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	...	.19
Powder blue	lb.	...	.18¾-.19¾
Rare earth hydrate 100 lb. drums	lb.	...	.35
325 lb. barrels	lb.	...	.30
Rochelle salts, bbls.	lb.	...	.12½
Rouge	lb.	...	Po. or Gr. .13½ / Cry.
Rutile (TiO_2) powdered, 95%	lb.	.10-.12	.13-.15
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	27.00
Selenium (Se) In 100 lb. lots	lb.	...	2.00
In lesser quantities	lb.	...	2.10
Silver nitrate ($AgNO_3$) . (100 oz. bot.) per oz.		...	.39
Soda ash (Na_2CO_3) dense, 58%— Bulk	Flat Per 100 lb.	1.10	...
In barrels	Per 100 lb.	1.50	...
In bags	Per 100 lb.	1.25	...
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.07
Sodium chromate ($Na_2CrO_4 10H_2O$)	lb.	...	.08½
Sodium fluosilicate (Na_2SiF_6)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Flake	Per 100 lb.	3.00	...
Solid	Per 100 lb.	2.60	...
Sodium nitrate ($NaNO_3$)— Refined (gran.) in bbls.	Per 100 lb.	...	2.00-2.25
95% and 97% Bulk	Per 100 lb.	1.225	...
200 lb bags		1.29	1.34
100 lb. bags		1.325	1.375
Sodium selenite (Na_2SeO_3)	lb.	..	1.80-2.00
Sodium uranate (Na_2UO_4) Orange	lb.	...	1.50 1.55
Yellow	lb.	...	1.50-1.55
Sodium uranyl carbonate	lb.	...	.80-.90
Sulphur (S)— Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Tin chloride ($SnCl_2$) (crystals) in bbls.	lb.	...	.33½
Tin oxide (SnO_2) in bbls.	lb.	...	.47
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	2.25
Yellow orange	lb.	...	1.50
Zinc oxide (ZnO) American process, Bags	lb.	.05	.05¼
White Seal, 150 lb. bbls.	lb.	.06¾	.07
Green Seal bags	lb.	.06	.06¼
Domestic White Seal bags	lb.	.06½	.06¾
Red Seal, bags	lb.	.05½	.05¾
Zircon Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude. Gran. (Milled .005-.02c higher)		.03½	.04-.05

EQUIPMENT AND SUPPLIES

A NEW GLASS LIME

Basic Dolomite, Inc., Cleveland, has introduced a new glass lime, called Calcimag, which is said to overcome losses from air slaking and hazard to workmen. This material is a free-flowing, dead-burned dolomitic lime, with approximately the density and grain size of glass sand. Calcimag is processed from commercially pure Niagara dolomite and the raw deposits are said to uniformly analyze at 55 per cent calcium carbonate and 44 per cent magnesium carbonate with impurities of less than one per cent. It is reported that in normal use, "Calcimag contains 99 per cent of glass-forming constituents."

RUBBER TO POLISH MOLDS

The possibilities of utilizing rubber for polishing glass molds are being emphasized by Weldon Roberts Rubber Co., 351 Sixth Ave., Newark, N. J. Several glass companies are reported to have already adopted Weldon Roberts Brightboy discs, lathe wheels and tablets and apparently others are interested in this development.

Brightboy is a rubber compound impregnated with abrasive. The binder is soft rubber, and this soft rubber is said to cushion the abrasive, preventing a harsh action. In the jewelry trade, for instance, Brightboy is used in prefinishing operations before the final rouge or buff. From this fact it can be seen that the finish obtained by using Brightboy is sufficiently smooth for molds and tools.

Stephens-Adamson Mfg. Co., Aurora, Ill., has appointed F. E. Dunlap branch manager in charge of conveyor sales and engineering for Michigan with offices in the Book Tower, Detroit. Mr. Dunlap has had wide experience in conveyor design and has specialized in the sand handling, foundry and automotive end of the business since 1919.

LEEDS & NORTHRUP CO. IN OPERATION SINCE 1899

In July on page 247, The GLASS INDUSTRY stated, "By way of celebrating their silver anniversary, Leeds & Northrup Co., Philadelphia, have introduced a new Micromax indicating recorder . . . . ." This erroneously gave the impression that the silver anniversary applied to the company, whereas it actually arises out of the fact that 25 years have elapsed since Leeds & Northrup introduced to industry the recording pyrometer of which this model is the latest form. The company itself, under the name of Morris E. Leeds & Co., was founded in 1899 and four years later was incorporated as the Leeds & Northrup Co. It was not until the later part of 1911 that the first recording, potentiometer pyrometer was introduced.

NEW SPRAY NOZZLE

Link-Belt Co., Chicago, announces that it has developed a simple non-clogging spray nozzle for spraying, washing and cleaning all kinds of materials, screens, etc. The width of the deflector is said to permit a comparatively large water jet and thus allow fairly large dirt particles to pass through the orifice without clogging it.

The device is described as a scientifically shaped, smoothly polished curved bronze deflector with a U-bolt for clamping the deflector securely to the water pipe in such a way that it is just above the orifice in the wall of the pipe. To assemble the deflector on the pipe, it is only necessary to place it in proper position over the orifice, and then tighten the hex nuts on the U-bolt.

Further details may be obtained by writing Link-Belt Co., 300 W. Pershing Road, Chicago, for their folder No. 1407.

A NEW CHECKER BLOCK

A new checker block which has aroused interest in the steel industry is now being offered to the glass industry for use in regenerative furnaces by William M. Bailey Co., Pittsburgh, Pa. Among the advantages claimed for "Superior" checkers are a maximum heating surface per cubic foot of checker volume as well as the proper proportions constructionally to give efficient heat absorption and transmission. Since its walls are less than 2½ inches thick, the maximum flue area is given, eliminating "dead brick" in so far as heat transfer is concerned. All the bricks are interlocked which is said to give strength and stability in the checker chamber.

General Refractories Co., Philadelphia, Pa. have moved their general offices into new quarters in the Real Estate Trust Building at Broad and Chestnut Streets.

The Carborundum Co., Niagara Falls, N. Y., is planning two additions to the office building at this plant. Each will be three stories high, 62 x 76 feet, forming wings to the existing building.

CATALOGS RECEIVED

How to Handle It If It Is Glass. Bulletin No. 268. Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis. Shows some of the many installations of Rex glass plant installations for the production of glass, emphasizing in particular the elimination of serious dust hazards. Treated are unloading equipment, storage equipment, weighing equipment, batch mixers, cullet handling equipment, coal and ash handling equipment and a typical Rex closed circuit batch mixing installation.

Gunite Castings for the Glass Industry. Gunite Foundries Corporation, Rockford, Ill. A chemical analysis and specific tests of the various properties of this iron for use in glass molds make this a particularly useful catalog. Illustrated are many types of castings and plunger patterns. A price list is included.

Photo-Micrographic Equipment. Catalog E-21. Bausch & Lomb Optical Co., Rochester, N. Y. An extremely able and handsomely conceived compilation of the various instruments produced by the company for low power and high power photomicrography. In addition to general articles, there are included specific description with prices of the many 'scopes.

Coordination with the Greatest of Ease. Brown Instrument Co., Philadelphia, Pa. A handsome broadside illustrating and describing the features of the air operated controllers recently introduced by this company.

Ruggedwear Resurfacer. Flexrock Co., 800 N. Delaware Ave., Philadelphia, Pa. An informative folder regarding the maintenance problem as it applies to floor surfaces. Salient points of this material as well as a check list of possible uses are provided.

How to Cut Screw Threads in the Lathe. Bulletin No. 36A. *How to Grind Lathe Tool Cutter Bits.* Bulletin No. 35. South Bend Lathe Works, South Bend, Ind. Two extremely useful and easily understandable publications fully illustrated to give the reader a clear-cut idea of each operation. A nominal charge of Ten Cents per copy is made to cover the cost of handling and postage.

Link-Belt Heating System. Link-Belt Co., 2410 West 18th St., Chicago. Describes a new heating system with Radiostat control to give a saving of an additional 15 per cent and more in the use of steam above the boiler room. Suggested for low-pressure jobs for buildings above a certain size.

Floor Trucks. Circular No. 220. Lewis-Shepard Co., 175 Walnut St., Watertown, Mass. Fully illustrated circular on easy rolling floor trucks for the interior transportation of all types of products, merchandise or goods.

Binoculars. Bausch & Lomb Optical Co., Rochester, N. Y. How to select the proper binoculars. Illustrated and with case histories and diagrams.

Huron River Silica Corporation, Detroit, Mich., is arranging for extensive developments of its silica sand properties at South Rockwood, Mich. This proven tract of land is said to have estimated reserves in excess of 20,000,000 tons.

BUILDING GLASS FOR URUGUAY

The Bureau of Foreign and Domestic Commerce has released to The GLASS INDUSTRY a report on Uruguay as a market for American building glass. The report was prepared by Vice-Consul H. Bartlett Wells, assigned to Montevideo.

Since window glass is not made in Uruguay, the import figures given below may be taken to represent consumption. Average prices of window glass in 1.8 millimeter thickness are 75 Belgian francs per hundred square feet; in 3 millimeter thickness, 132 Belgian francs per hundred square feet.

Imports Ordinary Flat Glass up to 4 Millimeters:
(Quantity in Kilograms)

Origin	1934	1935
Belgium	472,412	914,808
Germany	500,818	683,506
Russia	.....	165,500
Others	251,888	101,500
Total	1,225,118	1,865,314

All flat roofs, the principal type in Montevideo, are furnished with skylights, a design presumably derived from the Spanish interior patio style. These skylights are composed of a frame of iron strips leading up to a ridge pole and supporting sheets of non-transparent glass about 5 to 6 millimeters thick. Consumption is relatively high as factories also use a great deal of this glass. Local manufacture was commenced in 1936, but is as yet in the experimental stage and does not enter heavily into consideration.

Statistics for the year 1935 given below must be carefully weighed in the light of developments during that year. In July, 1935 Montevideo was struck by an extremely violent windstorm attended by hail, and what skylights were not bodily torn from their sliding rails had at least most of their glass broken. The heavy imports recorded for 1935 were occasioned by the necessity of replacing the glass destroyed by this tempest.

Skylight glass is quoted at about 1.50 Reichsmarks per square meter, C.I.F. Montevideo, in 5 to 6 millimeter thicknesses.

Imports of Skylight Glass
(Quantity in Kilos)

Origin	1934	1935
Belgium	329,000	669,081
France	84,457	316,741
Germany	84,130	407,130
United States	48,470	...
Others	.....	188,310
Total	515,072	2,532,162

According to reports from the trade, no architectural glass is used in Uruguay save in the shop-facing or display-window background which consists of pieces of mirror glass about 1 x 2 inches set like tiles. No other ornamental glass has been reported but the prevalence in Montevideo's most modern dwelling, apartment, and office building styles of modernistic trend would seem to indicate that a very good opening could be found for glass brick and architectural ornaments of cast glass, such as grilles and panels. This market would of course, be sharply limited by the price at which the glass is sold, but it is reasonable to suppose that the excellent manner in which they would harmonize with the best examples of local architectural styles would in many cases be sufficiently convincing to stimulate their use.

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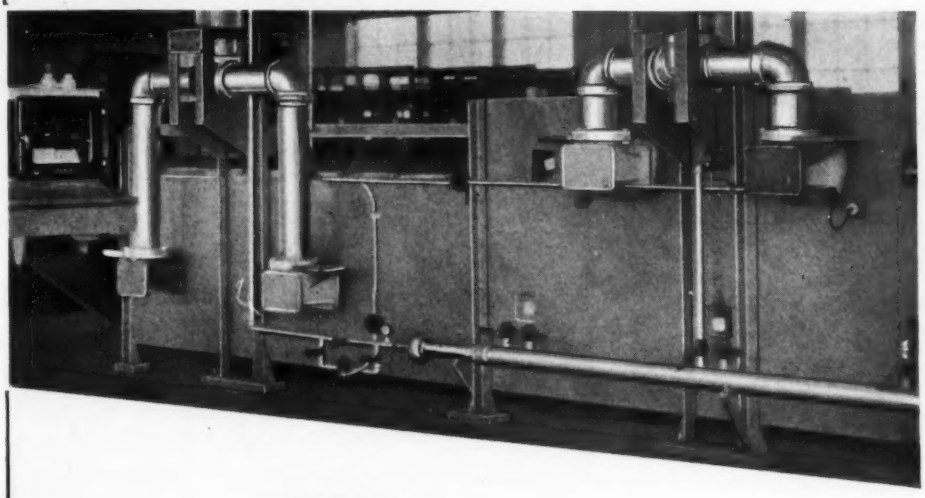

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